# THE CARE AND FEEDING OF APPENDIX A

An Implementation Guide to the Fish/Water Quality Objectives

of the

Nez Perce National Forest Plan


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## INTRODUCTION

This document is an implementation guide for Appendix A of the Nez Perce National Forest Plan. It provides interpretation on how the fish/water quality objectives are to be applied. The guidance contained herein is generally not new. Most of these interpretations have been provided previously in response to situations which have arisen during Forest Plan implementation. This guide documents them in a convenient format for Forestwide application.

More complete background and explanation of Appendix A can be found in the Forest Plan and Resource Documentation Reports for Water and Fisheries (USDA Forest Service, 1987, Gerhardt and Johnson, 1988, and Stowell, 1986).

The foundation of Appendix A is the fish/water quality objective which is listed for each nonwilderness prescription watershed on the Forest. These objectives are expressed as percent fish habitat potential and range from 70% to 100% depending upon beneficial use and planned land management in each watershed. The objective for wilderness prescription watersheds is 100%. The fish/water quality objectives are intended to reflect all the stream channel, riparian, and water quality variables which affect fish habitat or other beneficial uses of water.

Associated with the objective for each watershed are the sediment yield and entry frequency guidelines. The sediment yield guideline is expressed as percent over baseline sediment yield. It is generally calculated using NEZSED, the Forest's version of the R1R4 sediment yield guide (Cline, et al, 1981). The entry frequency guideline is expressed as number of allowable entries per decade.

Although sediment yield analysis is the primary quantitative scheduling tool advocated in the Forest Plan when evaluating fish/water quality objectives, it is not intended to be the only one. The results of sediment yield modeling must be interpreted and used in conjunction with other information to determine how the fish/water quality objectives can be met. This direction is provided for Forestwide standards and guidelines and in a footnote to Appendix A of the Forest Plan.

## NATURE OF FISH/WATER QUALITY OBJECTIVES

The fish/water quality objectives in the Forest Plan were established considering legal direction and public desires to maintain beneficial uses of water. The primary beneficial uses considered in establishment of the objectives were fisheries and municipal water supply. The Clean Water Act formed a legal bottom line for the objectives. One of the stated goals of the Act was to achieve fishable waters. The fish/water quality objectives are stated in terms of percent habitat potential. Through analysis, it was estimated that 70% of habitat potential was sufficient to provide for a fishable surplus population. It was also assumed that this provided a minimum acceptable level of water quality. Thus, all watersheds on the Forest were assigned an objective of 70% or greater. Watersheds which support steelhead or westslope cutthroat trout, but not chinook salmon were assigned an 80% objective. Watersheds which support chinook salmon or serve municipal water supplies were assigned a 90% objective. This general guidance varied somewhat based on negotiations with the Idaho Department of Fish and Game.

Since the objectives are based on the concept of potential, it is important to gain common understanding of this term. In the Forest Plan, maximum resource potential is defined as "the maximum possible output of a given resource, limited only by its inherent physical and biological characteristics". Considerable debate has resulted due to the ambiguity of this definition. It has been established that this potential relates to a stream's inherent natural capability to produce fish. This can be further expanded to include other beneficial uses, such as municipal water supply. It is recognized that fish habitat quality changes over time under natural conditions. Thus, a stream unaltered by human activities may or may not be at its natural potential at any point in time. The natural potential for any given habitat variable is a theoretical or measurable optimum condition for that variable considering natural cycles of disturbance and recovery. It should be noted that streams with a naturally low fish production capacity or poor water quality due to unfavorable or sensitive natural conditions may have a lower tolerance for timber and other land management activities than higher quality or less sensitive streams. This should be considered when assessing impacts of activities and in their planning and scheduling.

At present, fish habitat potential and existing condition are best defined in terms of eight variables which can be measured or estimated during stream surveys or monitoring studies. These values are quantified in a set of desired future condition (DFC) tables used on the Clearwater and Nez Perce Forests. The existing values in the DFC tables were developed utilizing stream survey data, theoretical data and literature reviews. Much of the information used to define the 100% level came from tributaries of the upper Lochsa River. Although these values were not derived from any single stream, they are considered achievable for many local streams under natural conditions in the absence of major disturbance. Until such time as reliable data are available to modify these tables, they will be used to assess compliance with fish habitat objectives as listed in Appendix A. For use on the Nez Perce, DFCs in these tables are displayed for habitat conditions of 70, 80, 90 and 100% of potential.

It is important to note that compliance with DFC numbers is not the sole criterion for determining a stream's existing or predicted future condition. This determination is a professional judgment made by aquatic resource specialists after consideration of all relevant information. Fisheries biologists will have the lead role in this process when fisheries is the resource under analysis. Other specialists, such as hydrologists, soil scientists or ecologists may have the lead role when other resources related to the fish/water quality objectives are being analyzed. Professional judgments are always to be accompanied by logical rationale and supported by applicable research.

If a situation arises in which the existing DFC tables are considered to be inaccurate, and better data are available, the process outlined in the Columbia River Basin Anadromous Fish Habitat Management Policy and Implementation Guide (USDA Forest Service, 1991) should be used to make modifications. Until this process is fully implementable, a Forestwide group of aquatic resource specialists should review any requests to utilize values different than those in the existing tables. Additionally, outside review will be sought from the Columbia River Inter-Tribal Fish Commission (CRITFC), Nez Perce Tribe, Idaho Department of Fish and Game and Idaho Department of Health and Welfare, Division of Environmental Quality. Other agencies, such as the National Marine Fisheries Service, may need to be consulted in the future or in specific instances.

Fish/water quality objectives are also considered applicable to variables beyond the eight presently being assessed. For example, effects of instream flow withdrawals may be assessed by comparison to the objectives. Another example may be to assess changes in turbidity as it affects municipal water use.

The Idaho Department of Health and Welfare (IDHW) has not issued an opinion as to whether the Forest's fish/water quality objectives are in compliance with State Water Quality Standards. In a letter dated January 7, 1988, the IDHW stated "In our opinion the final plan complies with the State Water Quality Standards". With respect to the fish/water quality objectives, the letter stated "The current Water Quality Standards provide no basis for evaluating the numerical limits listed in these objectives." It is the Forest's assumption that the Forest Plan is in compliance with existing standards. This may change if the State's proposed sediment criteria presently under review are adopted.

## HOW OBJECTIVES ARE AMENDED

The fish/water quality objectives are routinely amended as new information becomes available. This is typically the result of stream surveys. Adjustments in the objectives are made based on changes in the recognized beneficial uses. For example, if a stream that formerly was thought to contain only steelhead and resident trout is found to support chinook salmon, the objective should be raised from 80% to 90%. This is documented as a Forest Plan amendment. In general, the results of stream surveys should be compiled annually and a single update to Appendix A made.

## USE OF WATERSHED DATABASE

Data for existing activity and physical characteristics of each prescription watershed are stored in the Nez Perce Watershed Database. The present database is System 2000 and resident at the Fort Collins Computer Center. Instructions for maintaining the database are found in a database dictionary and associated documents (Hatter and Gerhardt, 1987). A database update to the ORACLE format, resident on the Forest's Data General system, is in progress and should be completed in 1991.

## USE OF NEZSED AND FISHSED

In order to determine if the sediment yield and entry frequency guidelines are being met, it will be necessary to run the Forest's sediment yield model (NEZSED). This model is resident on the

Forest and district Data General computer systems.  A user guide is available to assist in running the model (Harmon and Gerhardt, 1989).

To predict the level of change in fish habitat due to sediment yield and deposition, it will be necessary to use the fish response model, FISHSED (Stowell, et al, 1983).  FISHSED is resident on the Forest's Data General system.  A user's guide is available (Green, 1991).

## USE OF WATER YIELD ANALYSIS

Water yield analysis has been deemphasized on the Forest due to a pre-Forest Plan analysis which demonstrated that sediment yield modeling was a more limiting activity constraint than water yield modeling in nearly all cases.  This is not to say that concern over increased water yield and its effect on stream channels does not exist.  Water yield analysis should be done in cases where vegetation removal, such as fire or timber harvest, occurs over a high proportion of a watershed area.  "High proportion" will vary depending upon watershed and climatic characteristics, but is generally considered to be when a watershed exceeds about 25 to 30 percent equivalent clearcut area.  Water yield is also an important analysis in unstable stream channels where flow increases could cause further channel damage.

If the Forest adopts the Region's WATSED model (USDA Forest Service, 1991), it will be possible to do sediment and water yield analysis from a common data file.  Water yield analysis can then be done efficiently in appropriate situations.  Future refinements in modeling capability may take into account changes in instantaneous peak flows, effects in small watersheds, link water yield changes to sediment and predict effects on channel stability.  These refinements should be incorporated into analyses when they become available.

## HOW TO MODEL ENTRIES

To answer this question requires an understanding of how certain relationships in FISHSED were developed and how they were applied in development of the Forest Plan entry frequency guidelines.  In FISHSED, a regression relationship was developed between habitat variables (e.g. cobble embeddedness) and modeled percent over baseline sediment yield.  The sediment yield was modeled by assuming that all activity occuring during the decade prior to the habitat field work had occurred in the same year (Stowell, personal communication).  As a result, relatively high sediment yields are required to show a corresponding change in fish habitat.  During development of the Forest Plan, it was decided to split this single dose of sediment into smaller "entries".  This was done in order to avoid large single year spikes of sediment yield which might exceed the geomorphic threshold capacity of the stream to flush sediment.  The allowable number of entries per decade varies by objective.  Although they vary by channel type (Rosgen, 1985 and 1989), examples of typical sediment yield and entry frequency guidelines are found in the following table (Gerhardt and Johnson, 1988):

| Fish/WQ Objective | FISHSED Sediment Yield | Forest Plan Sed Yield Guideline | Forest Plan Entry Freq Guideline |
|---|---|---|---|
| 90% | 30% | 30% | 1X per decade |
| 80% | 90% | 45% | 2X per decade |
| 70% | 180% | 60% | 3X per decade |

The significance of this transformation from FISHSED to the Forest Plan is in how activities are modeled with respect to their activity year. The simplest case is that of a watershed with 90% objective. In this case, only one entry per decade is allowed. A timber sale entry typically consists of road construction and timber harvest. In the case of a one entry per decade watershed, it is important that these two phases be modeled as one peak. Thus, the same activity year is assigned to all roads and harvest units, despite the fact that these activities are typically spread out over several years. This is necessary in order to meet the assumptions under which Appendix A was developed.

In cases of watersheds which have 70% and 80% objectives, more than one entry per decade is allowed. In these instances, some options exist for how entries can be modeled. For example, in the case of a watershed with an 80% objective, B-channel type, two entries of 45% over base rate each are allowed. This could be modeled as two separate timber sales with roads and units modeled with the same activity year for each sale, with each peak not to exceed 45% over base rate. Another option would be to model one timber sale with the roads accounting for a single peak up to 45% and the subsequent harvest units being the other peak. In this instance, generally only one timber sale could occur in the watershed in that decade. Another common scenario is for capital investment road construction to occur one or two years prior to a timber sale entry. In this case, the capital investment construction represents one entry and the timber sale the second. The same principles apply to 70% objective watersheds with three entries per decade as with 80% objective watersheds.

It is important to note that once activities have been completed on the ground, they are to be added into the watershed database. In the database, the actual activity years are used, rather than the "entry date". This allows the most accurate portrayal of existing sediment yields. The user then interprets model results to determine the significance of sediment from existing activities.

## WHAT IS AN ENTRY

This question comes up in cases where relatively minor activities are being evaluated. In most instances, some road construction, reconstruction or other significant ground-disturbing activity must occur for an activity to qualify as an entry. Small timber sales with units harvested from existing access and away from stream channels generally would not be considered an entry. Timber harvesting which results in appreciable ground disturbance, and/or is close enough to the channel system where sediment delivery is likely, would be considered an entry.

There is no simple rule stipulating the size of % increase needed to be an entry. This is highly dependent upon the size of the watershed. In small watersheds, a small amount of activity often results in a high % increase. In successively larger watersheds, a substantial entry may result in only a small percentage increase. Professional judgment must be used to determine when an entry has occurred.

## CUMULATIVE EFFECTS ANALYSIS

Due to the way which the Nez Perce prescription watersheds are delineated, it is often necessary to conduct a sediment analysis on larger watersheds which consist of more than one prescription watershed. The R1R4 Guide suggests that the valid size range for modeling sediment using the R1R4 approach is 4 to 40 square miles. On the Nez Perce, fish/water quality objectives and associated sediment yield and entry frequency guidelines have been established for watersheds outside these recommended limitations. Under the Forest Plan, NEZSED analyses have been conducted for watersheds up to about 150 square miles (e.g. Red River and Slate Creek). The largest watershed on the Nez Perce for which such an analysis is recommended is Meadow Creek at about 240 square miles. This is the largest watershed for which sediment yield and entry frequency guidelines are listed in Appendix A. Consultation with the research community suggested that this was a reasonable upper limit for application of the R1R4 Guide (King, 1991). It is not recommended that NEZSED be used for watersheds the size of the South Fork Clearwater River or Selway River without first consulting the research community and assessing needs for modification of the model.

In Appendix A, numerous prescription watersheds which are not true watersheds are assigned fish/water quality objectives. These are footnoted with the following statement:

> *"These prescription watersheds, unlike most, are not true watersheds. By definition, a true watershed includes all the lands draining through a stream reach. These footnoted watersheds drain only part of such a hydrologic unit and generally contain the downstream reaches of relatively large streams. For sediment yield analyses on these downstream reaches, all upstream prescription watersheds are combined into a true watershed. Sediment yield guidelines ... apply only to true watersheds. Entry frequency guidelines ... apply to prescription watersheds regardless of whether they are true watersheds."*

An example may be useful to illustrate the intent of the above footnote. The Slate Creek watershed at the Forest boundary consists of 19 prescription watersheds with a total area of 122 square miles. Each of these watersheds has an objective ranging from 70 to 90% and an associated sediment yield and entry frequency guideline. Lower Main Slate Creek (watershed #17060209-02-22) is an example of a prescription watershed which is not a true watershed. It has an objective of 90% with a sediment yield guideline of 30% over base rate and an entry frequency guideline of one entry per decade. To implement the intent of the above footnote, cumulative effects analysis would need to be done when significant entries are planned anywhere in the Slate Creek watershed to ensure that the predicted sediment yield does not exceed 30%

over base at the Forest Boundary. Entries should be kept to one per decade (or its reasonable equivalent) within watershed #22. It is not the intent of the footnote to permit only one entry per decade in the entire Slate Creek watershed.

As watersheds become larger, the analyses become more complex. It will generally be necessary to secure the assistance of a hydrologist and, at times, other resource specialists in order to properly assess larger watersheds.

## FACE DRAINAGES AND SMALL PRESCRIPTION WATERSHEDS

When prescription watersheds were initially delineated in 1980, numerous small face drainages were left unnumbered. In 1988, these were designated prescription watersheds with the number "99" as the last two digits. Although not specified in the Forest Plan, the assumed fish/water quality objective for these faces is 70%. No sediment yield or entry frequency guidelines have been assigned since the watersheds contained within the faces are generally too small to be validly modeled using the R1R4 approach. The guiding philosophy in these watersheds should be to apply Best Management Practices (BMPs as defined in the Idaho State Water Quality Standards), Forest Plan standards and guidelines, site-specific mitigation measures as defined in the project National Environmental Policy Act (NEPA) document and a reasonable schedule of activities.

In addition to the above face drainages, a number of prescription watersheds listed in Appendix A are below the size range recommended for sediment analysis using the R1R4 approach. For drainages below about two square miles in area, NEZSED results must be interpreted cautiously. Due to the small drainage area, relatively small amounts of activities can give anomalously high % over base sediment yields. Each such situation should be evaluated individually, but in general, direction similar to the "99" watersheds should be applied.

## NON-PRESCRIPTION WATERSHEDS

In some cases, it may be necessary or desirable to evaluate sediment yield on a watershed other than a designated prescription watershed. One example would be if a significant drainage is located inside of a prescription watershed. In this case, an appropriate defacto objective, along with sediment yield and entry frequency guidelines should be established using the same approach as the Forest Plan. It is not recommended that any more prescription watersheds be established unless an overriding need to do so exists.

Watershed and fisheries analyses can and should be conducted at appropriate points regardless of whether a prescription watershed happens to break there. NEZSED allows for establishment of a user defined project file to facilitate analysis of non-prescription watersheds. To do this requires establishing the natural sediment yield for the watershed. One first obtains the unit area base sediment rate for each landtype from the the Forest watershed files. Knowing the landtype areas, watershed area and routing coefficient then allows calculation of the base sediment yield.

## MODEL ACCURACY

There is error inherent in sediment modeling. Neither NEZSED nor the general R1R4 approach have been rigorously tested over a range of conditions to determine their accuracy. Limited testing has suggested that the accuracy of NEZSED may be within 30 to 50 percent of actual values of percent over base sediment yield when applied to third order watersheds in the Horse Creek research study. In Appendix A, the sediment yield guideline is defined as an "approximate maximum sediment yield...". For these two reasons, it is necessary to apply professional judgment when interpreting the validity of NEZSED outputs. Due to the numerous complexities and complications associated with sediment modeling, there is no fixed plus or minus tolerance figure which is recommended to determine compliance with the sediment yield guidelines. This must be determined on a case-by-case basis using professional judgment.

## BELOW OBJECTIVE WATERSHEDS AND IMPROVING TREND

Appendix A to the Nez Perce Forest Plan identifies 86 prescription watersheds which were considered to be below objective. In 19 prescription watersheds within the Newsome Creek and Upper Red River drainages, management-derived sediment is not allowed until monitoring indicates that habitat has recovered to planned levels. In 67 below objective watersheds, footnotes in Appendix A provide for continued development activities, contingent upon an improving trend.

For streams affected primarily by past dredge mining, the footnote reads:

> *"...Timber management activities can occur in these drainages, concurrent with habitat improvement efforts, as long as habitat capacity shows a positive, upward trend."*

For streams where excess sediment is a primary limiting factor, the footnotes in part read:

> *"...Timber management can occur in these watersheds, concurrent with improvement efforts, as long as a positive, upward trend in habitat carrying capacity is indicated."*

Recent field surveys suggest that the number of streams that are below Forest Plan objectives in their existing condition is greater than the 86 known to exist at the time the Plan was written. Depending on the situation, this may be due to a variety of past impacts, either natural or man-caused. The logic of Appendix A regarding below objective streams (other than those where no activity is permitted until recovery to Forest Plan objectives is confirmed) is that an upward trend will be established. This may be done expressly for this purpose or in conjunction with timber or other resource management. If analysis shows a stream to be below Forest Plan objectives in its existing condition, due to either natural causes or past management, management should be invoked to establish an upward trend regardless of whether or not the stream is listed as below objective in Appendix A.

Determinations of existing condition will be based on rigorous technical analysis. This analysis should indicate, based on survey data, DFC numbers, research, available literature, and professional judgment, whether or not a given stream is above or below the Forest Plan objective. The comparison to DFC numbers is not the sole criterion for determination of existing condition. It is also important that the causative factors leading to the below-objective determination are established. In this way, prescriptions resulting in an upward trend can be developed.

Upward trend means that stream conditions determined through analysis to be below the Forest Plan objective will move toward the objective over time. Stream specific determination of existing condition and present or future improving trend should be done through a convergence of evidence using stream surveys, monitoring results, watershed condition inventories, literature reviews, predictive modeling and/or professional judgment. At the conclusion of the analysis, it must be demonstrable that an improving trend is either in place and will continue, or that an improving trend will be initiated as a result of past, present and future management activities. The Plan did not specifically intend that the improving trend be in place prior to initiation of new activities, but in the majority of cases this will be true as the Forest has been aggressively pursuing habitat and watershed improvements since at least 1985. This is also expected to be the case in many watersheds where natural causes have resulted in a below objective condition. This is because it has been many years since major flood or fire events have extensively impacted non-wilderness watersheds on the Forest.

Although the Plan specifically mentions timber harvest occurring concurrently with an improving trend, the same principle should be applied when assessing other activities such as road construction, grazing, mining, etc.

The Plan did not specify a time factor for achieving fish/water quality objectives in below objective watersheds, except to state that improvements were to be scheduled through 1995. Depending on the causative factors, it may or may not be possible to accurately predict the rate and endpoint of recovery. With all habitat components except sediment, the improving trend should be continuously upward, with no temporary downturns or reduction in the rate of improvement. It is recognized that any new sediment inputs, could be judged to be a downturn or lowering of the rate of improving trend. With sediment, the key is that new sediment inputs remain below the general flushing rates considering stream power and the fish/water quality objective of the stream (see further discussion below). This approach to future sediment is not applicable to the 19 specified watersheds in Red River and Newsome Creek, where the trend should be continuously upward and at a maximum feasible rate.

The improving trend prescription will depend on what is causing the stream to be below objective. A simple example would be a stream which is below objective due to a lack of habitat diversity resulting from dredge mining. In this situation, direct habitat improvements may be the best way to improve existing condition of the stream. Another example is a stream where acting and/or potential large woody debris are below desired levels. In this case, riparian management should result in improved woody debris recruitment over time. Similarly, if water temperature is identified as a problem, management which would result in water temperature improvements would be implemented.

Where deposited sediment is a primary concern, sediment sources in the watershed need to be identified and stabilized where feasible and appropriate. If sediment yield is reduced or maintained at a low level, the stream should begin to flush the deposited sediment. In some cases, direct removal of deposited sediment may be desirable. Where deposited sediment is a limiting factor, a probable prescription for improving trend is to keep predicted sediment yield below that specified in the sediment yield guideline for that watershed in Appendix A. This could theoretically provide some excess flushing capacity to remove accumulated sediment. During project level analysis, it will likely be determined that some watersheds in addition to Newsome Creek and Red River should be deferred from sediment producing activities for a period of time.

Appendix A limits the magnitude and timing of predicted peak year sediment yields. It does not address the implications of the long term lower level sediment yields associated with watershed development activities. The reality is that sediment is not instantaneously delivered in discrete, first year peaks as suggested by the simplistic routing procedure in the R1R4 approach. The suspended sediment portion may behave this way, subject to climatic variations, but bedload sediment is routed through the system over a period of years. It is considered valid, given present technology to continue to schedule activities using the Appendix A approach. Although one cannot dismiss the significance of the long term predicted sediment yields, within the context of the approach specified in Appendix A they are considered less critical than the sediment volumes associated with the predicted peaks.

Where sediment deposition is the problem, and natural sediment flushing rates are being relied upon for recovery, technology is not readily available to accurately predict recovery rates. There are more sophisticated sediment routing tools available than commonly used on the Forest. These have not been explored in enough depth to determine their applicability to local conditions. In order for this to happen, staffing, funding and priorities at both the Forest and research levels would need to change. Until better tools are available, it is important that each assessment portray as well as possible existing condition, prescription for recovery and the estimated rate of recovery for streams being analyzed.

Line officers who sign NEPA decision documents will select tradeoffs between timber and other resource management and measures to insure an upward stream trend if that choice is necessary. In all cases, discussions of upward trend in project NEPA documents will include:

1. A determination of which components in which streams are below the Forest Plan objective prior to initiation of a project.

2. Importance of the streams to fisheries or other beneficial uses.

3. The extent and magnitude of past human-caused impacts and past natural impacts.

4. A range of actions designed to achieve different levels of upward trend if that is necessary for a reasoned choice among alternatives.

5. Possible mitigation measures to compensate for past impacts. This will follow 40 CFR 1508.20 and will include consideration of avoidance.

6. Effectiveness of mitigation measures in compensating for past impacts together with reducing impacts caused by the project.

7. Disclosure of incomplete or unavailable information as required by 40 CFR 1502.22. This would include a discussion of technological limitations on accurately predicting the time necessary for stream recovery.

8. Mitigation which must be imposed to meet Clean Water Act requirements, including possible additional BMPs for Stream Segments of Concern.

9. Adoption of mitigation measures in the Record of Decision/Decision Notice. If mitigation measures specified in the NEPA document are not adopted, the decision documents will explain why not (40 CFR 1505.2).

10. Any monitoring over and above Forest Plan requirements necessary to demonstrate that an improving trend either does or does not exist.

11. Relative importance and urgency of treating fish habitat and water related resources.

It was the intent of the Plan that field-based monitoring be used to establish whether or not the improving trend was being achieved. The Plan was site-specific in its fish habitat monitoring requirements for 22 fixed stream reaches. Since then it has become apparent that monitoring in the form of implementation monitoring and periodic stream surveys using the basinwide methodology will be needed in all major streams, with particular emphasis on streams below objectives and State-designated Stream Segments of Concern. Documentation of specific monitoring requirements should be contained in Records of Decision and Decision Notices for individual EISs and EAs and in the annual Forestwide monitoring plan. Significant staffing and funding commitments will be necessary to meet monitoring needs.

## HOW TO MODEL ROAD RECONSTRUCTION

Roads are the largest sediment producing activities considered within the R1R4 Sediment Guide (Cline, et al, 1981). Modeling of existing and proposed roads is discussed within the appropriate sections of the Watershed Database Dictionary (Hatter and Gerhardt, 1987). Road reconstruction can have sediment impacts under some circumstances. Guidance for modeling sediment yield from road reconstruction in NEZSED is provided in this section. For sediment modeling purposes road reconstruction is divided into four categories:

Minor - This generally involves grading and shaping of the road with little or no earthwork. There may be minor drainage work such as adding waterbars and replacing or adding a few culverts generally not on live streams. This level of reconstruction is considered the same as maintenance and no additional sediment is predicted beyond that for an existing road. The mitigation coefficient is adjusted to account for conditions after the reconstruction. In some cases, this may result in an immmediate decrease in predicted sediment yield. An example would be if rock surfacing were added to a road to reduce surface erosion.

Moderate - This includes all of the activities considered under minor reconstruction in addition to the following. Some widening may occur along the road (e.g. turnout, curves, etc.), but it is not continuous. There may be significant drainage work, including replacement of a few live water crossings. There is a considerable amount of earthwork. This degree of reconstruction can be modeled using the second year basic erosion rate as defined in the R1R4 Guide. This will result in a temporary increase in predicted erosion which will last one year. The erosion will generally decrease in subsequent years due to typically enhanced mitigation following reconstruction.

Major - This includes all of the activities considered under minor and moderate reconstruction. The difference is that the road is generally widened and/or realigned along most or all of its length. Substantial additions or replacement of drainage structures typically occurs. The result is new cutslopes, fillslopes, and running surface which causes the road to behave as a new road would. Thus, the road is modeled as a first year road. The road width often increases, also. Predicted erosion generally increases above existing for the first two years after reconstruction. It often decreases by the third year due to enhanced mitigation commonly associated with reconstruction.

Modified Major - This category is used on major reconstruction projects which do not meet the assumptions of a new road. In these instances, it is possible to modify whichever coefficients are appropriate to best approximate the conditions on the reconstructed road. An example of modified major reconstruction is when a road is widened by removing material from the cutslope and adding it to the subgrade rather than over the fillslope. The result is a major reconstruction with a partially impacted fillslope. Similar modifications to the above assumptions could apply to minor or moderate reconstruction.

## WHEN TO MODEL FIRE

The R1R4 Guide contains coefficients and a procedure for modeling surface erosion impacts of fire. For purposes of calculating sediment yield due to man-caused activities, natural fire burning under natural conditions is assumed to be part of the base rate sediment yield. If a lightning-caused fire is burning through unnatural fuel accumulations (e.g. logging slash), it may be necessary to model this as an activity since assumptions of natural conditions are no longer met. In some situations, it may be desirable to model the conditions of a watershed to assess conditions immediately after a natural fire. In this instance, natural fire would be modeled.

Man-caused wildfire is modeled as an activity and stored in the Watershed Database. The Forest has traditionally not modeled the sediment yield associated with site preparation following timber harvest. This may change in the future since coefficients for site prep have been developed for WATSED. Extensive prescribed fire such as that done for elk winter range enhancement should be modeled as an activity and stored in the database.

## MASS WASTING AND BANK EROSION

The R1R4 Guide and NEZSED predict activity sediment yield for surface erosion and mass erosion of individual events less than ten cubic yards in volume. Large mass erosion events are not considered. Mass erosion rates are considered in the assumptions from which natural erosion rates were developed. The Forest has not conducted an inventory of activity-related mass erosion of sufficient extent to develop mass erosion acceleration rates. There are areas on the Forest where mass erosion is an important consideration. Examples include breaklands along the Selway, South Fork Clearwater, and Salmon Rivers. Landtypes are also rated according to mass erosion hazard (Green and Kellogg, 1987). When activities are evaluated in unstable areas, mass failure hazard analysis should be conducted. Assistance of a geotechnical engineer, soil scientist, and/or hydrologist should be obtained.

Bank erosion due to activities is also not considered in the R1R4 Guide or NEZSED. If bank erosion due to activities is a significant sediment source, then a separate analysis should be conducted. Some new quantitative tools are under development to assess bank erosion. To utilize these will typically require the skills of a hydrologist and may require soils or geotechnical engineering expertise.

## SEDIMENT IMPACTS OTHER THAN ROADS, TIMBER HARVEST AND FIRE

The R1R4 Guide and NEZSED provide coefficients to predict sediment yield from roads, timber harvest and fire. It is often necessary to evaluate impacts from other types of activities. A typical example is mining. Some components of mining projects may have disturbance and erosion characteristics similar to roads. In these cases, it is recommended that the road erosion coefficients be utilized with appropriate modifications for disturbance width and length and mitigation effectiveness. It is important to determine when the activity is functioning outside the assumptions appropriate for road erosion. At this point, some other type of assessment is needed.

Another example is erosion resulting from grazing. This can take two main forms, bank erosion from damaged stream banks and surface erosion from exposed soil. Sediment impacts from grazing need to be evaluated through means other than the R1R4 approach. One possibility is to use the COWFISH model, which was developed specifically to address grazing impacts (Lloyd, 1985).

## IMPACTS OTHER THAN SEDIMENT

The fish/water quality objectives should be evaluated with respect to all significant variables which could potentially affect fish habitat or other beneficial uses of water. The Forest has emphasized sediment analysis because of its importance, obvious linkage to management activities and the availability of quantitative assessment models. Sediment is an important factor affecting beneficial uses of water, but it is not the only one. It must be evaluated in perspective with other factors.

The fish habitat variables presently being collected in stream surveys and analyzed in project assessments are cobble embeddedness, pool/riffle ratio, water temperature, bank stability, bank cover, instream cover, and acting and potential large woody debris. Instream flow is an important consideration when assessing projects which may involve flow withdrawal. Chemical constituents and turbidity may be important variables in some situations. It is also important to understand the impacts of management on the stability and configuration of stream channels.

Models are available to predict management impacts on some of the above variables, but not others. If a quantitative predictive model is available and practical, it should be used. If not, best professional judgment will be the best method of analysis. Determining which variables to assess should be based upon importance of the variable to the beneficial uses and the risk which the activity has at affecting that variable. It is not feasible or necessary to attempt to evaluate every fish habitat/water quality variable imaginable in each project level assessment. Users are referred to the Northern Region effects analysis document for reference (USDA Forest Service, 1990).

## RIPARIAN MANAGEMENT

Condition and management of riparian areas are key in determining whether fish/water quality objectives can be met. Riparian condition is often the limiting factor in below objective situations. It is critical that riparian areas be considered carefully and treated accordingly in any activities. There is substantial legal and policy direction which applies to riparian areas and which must be followed. The Forest Plan contains direction for managing riparian areas under Forestwide and Management Area 10 standards and guidelines.

Specific direction for timber management in riparian areas is provided in a Forest field guide (Green and Gerhardt, 1991). Direction for other activities must be sought from other sources or tailored to meet specific situations. Particular challenges are associated with roads, placer mining and grazing activities. Careful coordination is required when these activities are associated with riparian areas. In cases of irresolvable conflict, Forest Service policy and Forest Plan standards stipulate that riparian dependent resources are given precedence.

## MITIGATION AND MITIGATION EFFECTIVENESS

Mitigation consists of efforts undertaken to minimize the impacts of activities. It is defined in National Environmental Policy Act as follows:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing the impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

It is critical that mitigation measures and mitigation effectiveness be discussed in NEPA documents. The Forest has prepared a guide to assist in documentation of mitigation effectiveness for common practices used to mimimize impacts of timber management and road construction on soil and water resources (Gerhardt, et al, 1991).

## IMPLICATIONS OF NON-NATIONAL FOREST LANDS

Inholdings of other ownerships are found within some prescription watersheds. These lands may have activities which affect National Forest stream segments lower in the watershed. It is important that the effects of these activities are considered during project level analysis. A technical recommendation should be made on appropriate Forest Service actions. The decision on extent of Forest Service response to these activities rests with the responsible official.

Another situation occurs where streams originate entirely on National Forest and flow onto other ownerships. In most of these cases, prescription watershed boundaries have been placed at the Forest boundary. Generally, analyses need only be carried to this point. In some instances, it may be necessary to conduct analyses to the mouth of the stream or other intermediate points in the watershed. An example would be where interagency cooperative efforts are underway.

The fish/water quality objectives are generally not applicable to non-National Forest stream segments unless adopted through some other agency's actions. The latter has been the case on adjacent lands administered by the BLM and under the State's Antidegradation program.

## MONITORING

Monitoring will play a key role in determining trends in fish/water quality conditions and whether objectives are being met. Forest Plan Appendix O contains the rudiments of a monitoring program. Additional documentation is in the Annual Monitoring Plan for Soil, Air, Water and Fisheries (Kenny and Gerhardt, 1991).

Some level of monitoring will eventually take place on all major streams on the Forest. Since intensive monitoring cannot take place on each stream, sampling and prioritization are key to an effective program. Among the criteria to be considered in prioritization is whether the stream is presently at, above or below its objective. Below objective streams should receive a higher priority for certain types of monitoring in order to determine whether an upward trend is being achieved. Priority should also be given to streams designated by the State as Stream Segments of Concern.

Monitoring protocol has not yet been thoroughly defined for analysis of upward trend. Techniques currently being used include the following:

1. Implementation monitoring of the mitigation measures and projects prescribed to accomplish the required improving trend.

2. Periodic resurveys using the basinwide methodology.

3. Intensive periodic measurements of selected reference reaches as specified in Appendix O to the Forest Plan.

## NEPA DOCUMENT FORMAT

The Forest has completed a general format to discuss water quality issues in NEPA documents (Parsell, et al, 1991). Additional direction on technical analysis needs for water quality and fisheries assessments will be prepared as needed. Until such direction is available, individual assistance will be provided. Regional direction is available in the "Our Approach ..." documents (USDA Forest Service, 1990).

## ROLE OF FIELD WORK AND PROFESSIONAL JUDGMENT

Present natural resource predictive models are gross simplifications of reality. They are simply support tools to be used to help make recommendations and decisions. Model results should not be used as the sole criterion for a decision. The results must be interpreted and combined with additional information before sound recommendations can be made. This approach is established in a footnote to Appendix A reads in part:

> *" ... Sediment model results will be used in conjunction with other factors and professional judgment to determine how fish/water quality objectives can be met".*

Given the present state of the predictive modeling art, there is no substitute for field knowledge and professional judgment in assessing existing conditions and predicting future conditions of streams and watersheds. Field work by trained, competent specialists is an essential prerequisite of a valid analysis. Professional judgment should always be accompanied by reasons and supported by available research. It is also subject to peer review.

## THE FUTURE

Technology, laws, interpretations and priorities are constantly changing. Nothing recommended in this document is intended to constrain use of new tools as they become available or to limit response to new conditions. An example of new direction is issuance of the Columbia River Basin Anadromous Fish Habitat Management Policy and Implementation Guide (USDA Forest Service, 1991). The direction provided in "Care and Feeding" is intended to be in compliance with the Guide. Additional changes will be forthcoming as a result of the proposed listing of Snake River wild chinook salmon as a threatened species.

The Forest team of aquatic resource specialists, including fisheries biologists, hydrologists and soil scientists must constantly maintain currency with new methods and direction. The future should not be constrained by the past. For a variety of technical and social reasons, water resource and fisheries analyses will become ever more rigorous and complex. It will require an innovative, competent and enthusiastic cadre of specialists to be equal to the task.

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